EOS, Transactions, American Geophysical Union Vol. 64, No. 12, Pages 113 – 120 March 22, 1983

Particles and Fields— Magnetosphere

1115 Interactions between solar wind and magnetosphere
COMPARISON OF S3-3 POLAR CAP POTENTIAL DROPS WITH THE INTERPLANETARY MAGNETIC FIELD AND MODELS OF MAGNETOPAUSE RECONNECTION
J. R. Wygant (Space Sciences Laboratory, University of California, Berkeley, California, 94720), R. B. Torbert, and F. S. Mozer

Measurements of the cross polar cap electric potential, by the double probe electric field experiment aboard S3-3, from fifty-five orbits in the dawn-dusk plane are compared to the reconnection electric fields predicted by a variety of models, both theoretical and experimental. The purpose of these comparisons is to understand the extent to which non-reconnection contributions to the polar cap potential must be included, to determine the time response of the polar cap potential to time varying reconnection rates, and to determine the efficiency and saturation levels of the reconnection process.

It is found that (1) After several hours of northward interplanetary magnetic field, the cross polar cap potential declines to progressively lower values than those after one hour of northward interplanetary magnetic field. This suggests that it requires several hours for the ionospheric polar cap potential to respond to the 'turning off' or 'turning down' of the reconnection process. (2) The decay of the polar cap potential is used to demonstrate that contributions to the polar cap potential not associated with the reconnection process can be limited to less than 20 kilovolts. It is shown that contributions to the polar cap potential that scale with the dynamic pressure of the solar wind are limited to less than one kilovolt. (3) The cross polar cap electric potential is best predicted by a weighted sum of contributions from interplanetary magnetic field parameters over the four hours previous to the measurement. The weighting functions have the form of an exponential decay of two to three hours with the strongest weight on interplanetary parameters over the one hour previous to the measurement. (4) For values of the dawn dusk component of the interplanetary electric field less than about 0.5 mV/meter, the measured polar cap potential is consistent with reconnection of all the interplanetary magnetic flux incident on a $30 R_E$ wide frontside magnetopause. For larger values of the dawn dusk component of the interplanetary electric field, the proportion of field lines reconnecting is less, indicating saturation of the reconnection process.

The above results are obtained when the extended response time of the magnetosphere to changes in interplanetary parameters is considered. They are independent of the detailed reconnection model assumed, and they are quite different from the viscous contribution, saturation levels of reconnection, and reconnection efficiencies inferred from comparisons of polar cap potentials to single hour averages of interplanetary parameters.

J. Geophys. Res., Blue, Paper 3A0177

5728 (Interactions Between Magnetosphere and Cosmic Rays)
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V.L. Patel, P.B. Ng (Department of Physics, University of Denver, Denver, CO 80208) and L.J. Cahill, Jr. (Space Science Center, University of Minnesota, Minneapolis, MN 55455)

5770 Short-period variations of magnetic field
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3-D Model of the Lithosphere-Asthenosphere Boundary for a Propagating Rift

Phillip D. Milholland and Frederick K. Duennebier
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University of Hawaii at Manoa
Honolulu, Hawaii

A first-order approximation of the lithosphere-asthenosphere boundary of a propagating rift model is shown in Figures 1 and 2. (Figure 1 is a reduced version of the cover figure. All bracketed letters in the text correspond to letters in Figure 2.) The propagating rift model explains tectonic patterns of some oceanic regions that have puzzled earth scientists for some time. According to this model, oceanic spreading centers can propagate through older crust, transferring portions of crust from one plate to another.

The two images in Figure 1 form a 3-D stereo pair of the lithosphere-asthenosphere boundary at a propagating rift. To view the 3-D model use a stereoscope on Figure 1; alternatively, stare at Figure 1 or the cover figure and let your eyes soft-focus until a 3-D image appears between the two printed images (believe us, it works). The model is based on the Galapagos propagator at 95.5°W, viewed from above and toward the southeast. The 'V'-shaped wedge of lithosphere between the pseudofaults is formed by extension of the eastern rift toward the viewer. As this rift propagates, spreading stops on the dying western rift, leaving a failed rift. Only two plates are present in the model, and depth to the asthenosphere depends only on age.

The stippled region (A) represents a cross section of the lithosphere and shows how the lithosphere thickens away from the rift. Depth to the ocean bottom (top boundary of A) is calculated by using the equations and assumptions of *Sclater and Francheteau* [1970] for a spreading center that spreads at a rate of 26 mm/yr. Depth is 2.1 km at the spreading center and increases to 3.1 km on the far right. Lithospheric thickness is calculated by using the equation of *Yoshi et al.* [1976]

$$L = 7.49(T)^{0.5}$$

where L is the thickness of the lithosphere in kilometers, and T is the age in millions of years. Depth to the lithosphere-asthenosphere boundary (bottom edge of A) is the sum of the ocean depth and lithospheric thickness. Thermal and isostatic adjustments that occur at the tip of the propagator and other boundaries have not been incorporated into the model and would tend to smooth the discontinuities and sharp boundaries. Depth is assumed to be a function of age only.

General configuration of the model corresponds to the 95.5°W Galapagos propagator [*Hey et al.*, 1980], except that the initial rifts of this model are offset by a 20-km-long transform fault (B2). Fracture zones (B1, B2–B3) associated with this transform fault terminate at the ends of the pseudofaults (C1, C2). The southern fracture zone (B2–B3) is composed of two sections: the fracture zone that existed when the transform was active (B3) and the original transform fault that was locked in place when rift propagation commenced (B2). As *Hey* [1977] pointed out, and as can be seen clearly here, the sense of vertical offset changes along the southern fracture zone instead of monotonically decreasing, as it does along a normal fracture zone. Intersections of the pseudofaults with the fracture zones mark the locations of lithosphere formed at the initiation of propagation. Propagation began at the initial transform fault and has extended the length of the eastern rift (D1) at a constant rate along a different azimuth. Extension of the propagating rift or propagator (D2) proceeds at the expense of the dying rift (D3). As spreading is transferred to the propagator, a portion of the dying rift is frozen into the southern plate and becomes a failed rift (D4). Orientation of the failed rift is controlled by the spreading rate and the extensional growth rate of the propagator. There are only two rigid plates in this model at all times.

Pseudofaults (C1, C2) stand out as large depth discontinuities in the lithosphere-asthenosphere boundary; these discontinuities reflect differences in age between new lithosphere formed at the propagator tip and old lithosphere through which the propagator extends. Vertical offset along the pseudofaults decreases away from the propagator tip because the difference in thickness decreases as both sections of the lithosphere age and because the propagator is extending through progressively older and thicker lithosphere. Note that no horizontal displacement occurs along the pseudofault boundaries, although vertical motion should result from differential aging across the boundaries.

The transform fault (E), which connects the propagator tip to the intersection of the dying and failed rifts, differs in important ways from the classical transform fault of a normal rift system. Material on both sides of the transform fault is formed by the same rift; consequently, there is no sharp age or thermal difference across the boundary. Also, the location of the transform fault is not fixed but moves in the same direction and at the same rate as rift propagation. Its length changes if the propagator is growing at a different azimuth from the dying rift. Note that what would be fracture zones (inactive portions of the transform) in a normal transform fault system are manifested by the northern pseudofault (C1) and by the zone between the southern pseudofault (C2) and the failed rift (D4). All interplate horizontal displacement occurs in the region between the propagator tip and the dying rift and is recognized by the change in azimuth between the dying and failed rifts. *Hey et al.* [1980] suggest that the transform fault of a propagating rift may be a zone of shear deformation rather than a localized fault boundary.

The existence of propagators in several areas has been postulated [*Hey*, 1977; *Hey et al.*, 1980; *Hey and Wilson*, 1980; *Delaney et al.* 1981]. Propagators, and the causes and consequences of propagation, will be one of the most interesting topics in plate tectonics to be studied during this decade.

Acknowledgments

This work is funded under National Science Foundation grant OCE-78-19816. The plotting software was written by J. Tuthill and D. Cuddy. The authors thank Jim Kellogg, Rita Pujalet, and Brian Taylor for critically reviewing this paper. This is Hawaii Institute of Geophysics Contribution 1358.

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Hey, R. N., F. K. Duennebier, and W. J. Morgan, Propagating rifts on midocean ridges, *J. Geophys. Res.*, *85*, 3647–3658, 1980.
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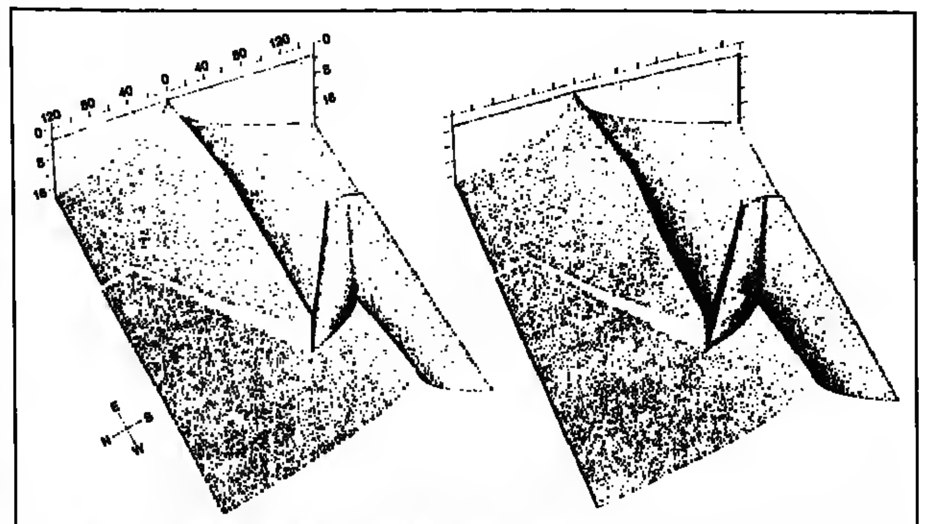

Fig. 1. A 3-D stereo pair of the lithosphere-asthenosphere boundary at a propagating rift. See text for details.

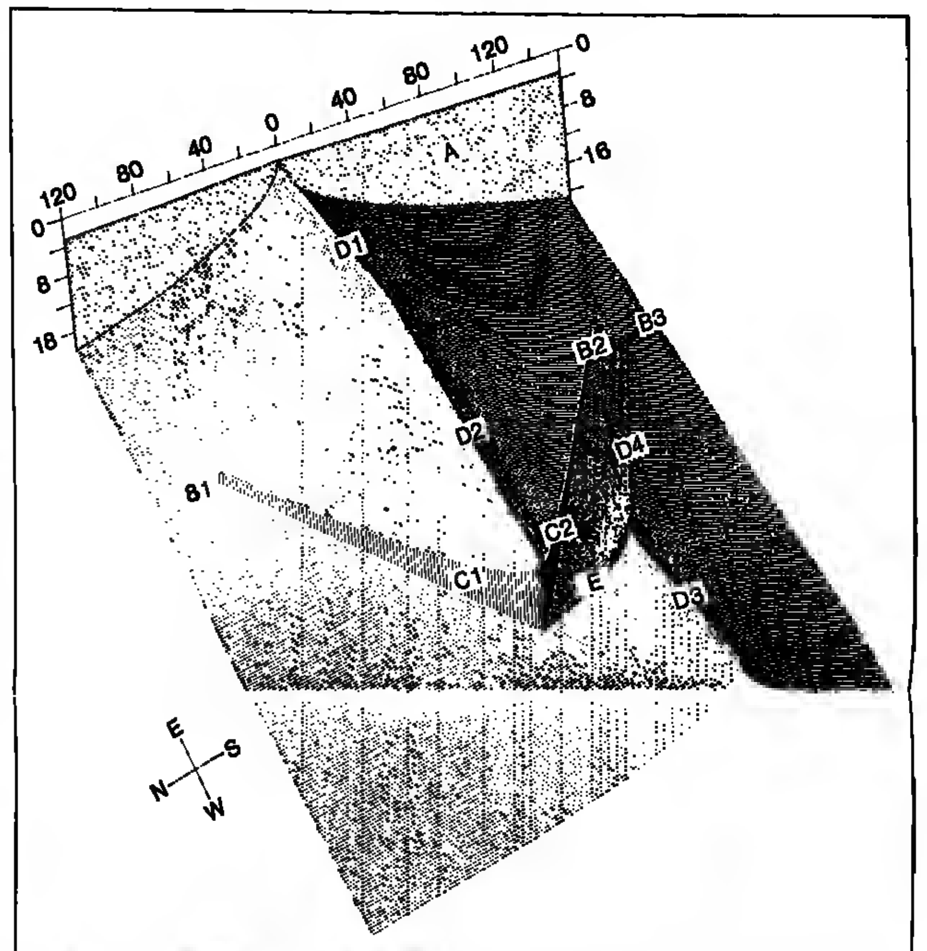

Fig. 2. (A) Lithosphere—The upper boundary is the depth below sea level (2.1–3.1 km), and the lower boundary is the lithosphere-asthenosphere boundary (2.1–21 km). (B) Fracture Zones—B1 and B3 are fracture zones that form from an original transform fault, B2, that is locked in place when rift propagation commences. (C) Pseudofaults—Pseudofaults mark the boundary of lithosphere formed by the propagator. The large vertical offset is a consequence of the large age difference across the boundary. (D) Rifts—D1 is an original rift from which the propagating rift or propagator, D2, arises. D3 is the dying rift which becomes inactive and forms the failed rift, D4, as the propagator usurps the spreading. (E) Transform Fault—The transform fault lies between the propagator tip and the end of the dying rift. It is significantly different from a classical transform fault in that material on both sides of the fault is formed by the same rift, there is no significant age difference across the fault, no fracture zones develop, and the fault must be repositioned at the same rate as the extensional growth rate of the propagator. Scale in kilometers.

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News

New NAE Head

Robert M. White, president of the University Corporation for Atmospheric Research (UCAR) and an AGU Fellow, has been elected president of the National Academy of Engineering (NAE). White's 4-year term begins July 1. He succeeds Courtland D. Perkins, who has been NAE president since 1975.

As NAE president, White will serve as vice chairman of the National Research Council (NRC). Frank Press, president of the National Academy of Sciences and former AGU president, is NRC chairman.

A search committee has been established at UCAR to find White's successor. For additional information, write to Thomas Donahue, Chairman, Search Committee, University Corporation for Atmospheric Research, P.O. Box 3000, Boulder, CO 80307. May 6 is the deadline for applications. UCAR, a consortium of 50 universities with doctoral programs in the atmospheric sciences or closely related fields, manages the National Center for Atmospheric Research under contract with the National Science Foundation. UCAR also carries on other activities to promote atmospheric science in the public interest.

New Weather Index

Scientists at the National Oceanic and Atmospheric Administration (NOAA) and the University of Delaware have refined the wind-chill factor, a common measurement of weather discomfort, into a new misery register called the weather stress index. In addition to the mix of temperature and wind speed data used to calculate wind chill, the recipe for the index adds two new ingredients—humidity and a dash of benchmark statistics—to estimate human reaction to weather conditions. NOAA says that the weather stress index estimates human reaction to weather conditions and that the reaction depends on variations from the 'normal' conditions in the locality involved.

Discomfort criteria for New Orleans, La., and Bismarck, N.D., for example, differ drastically. According to NOAA, when it's the middle of winter and it's -10°C with a relative humidity of 80% and 24 km/h winds, persons in New Orleans would be highly stressed while those in Bismarck wouldn't bat an eye.

NOAA plans to generate daily, weekly, and monthly weather-stress maps of the United States.

TV Special on Geophysics

Earthquake prediction, earthquake preparation in California and Japan, the theory of plate tectonics, and the causes and effects of earthquakes and volcanoes will be the subjects of a National Geographic television special scheduled to air on public television on April 6.

Among the locations visited by 'Born of Fire' are Iceland, where magma oozes to the surface on the remote island of Heimaey, illustrating the moving crustal plates; the Republic of Djibouti in east Africa, where some scientists believe a new ocean will form as three crustal plates spread apart; and the island of Santorini in the Aegean Sea, where a series of earthquakes and volcanic eruptions some 3,500 years ago destroyed two-thirds of the island and obliterated the city of Akrotiri.

The special, featuring geologist Robert Ballard of the Woods Hole Oceanographic Institution, is produced by the National Geographic Society and WQED of Pittsburgh with a continuing grant from Gulf Oil Corporation. Check local television listings for time and station.

Geophysical Events

This is a summary of *SEAN Bulletin, 8*(2), February 28, 1983, a publication of the Smithsonian Institution. The complete Long Valley, Colima, and Langila reports are included; the earthquake report is an excerpt.

The complete bulletin is available in the microfiche edition of *Eos* as a microfiche supplement or as a paper reprint. Subscriptions to *SEAN Bulletin* are also available. For the microfiche, order document E83-003 at $2.50 from AGU Fulfillment, 2000 Florida Avenue, N.W., Washington, DC 20009. For reprints, order *SEAN Bulletin* (give volume and issue numbers and issue date) through AGU Separates; $3.50 for one copy of each issue number for those who do not have a deposit account; $2 for those who do; additional copies of each issue number are $1.00. For a subscription, order *SEAN Bulletin* from AGU Fulfillment; The price is $18.00 for 12 monthly issues mailed to a United States address; $28.00 (U.S.) if mailed elsewhere. Orders must be prepaid.

Volcanic Events

Kilauea (Hawaii): Renewed fountaining and lava flow production on E Rift.
Mt. St. Helens (Washington): Spine added to February lobe, then extrusion stops; seismicity suggests renewed extrusion by late March.
Long Valley (California): Seismicity remains elevated, but no new swarms.
El Chichón (México): Little change to N hemisphere cloud; tiny aerosols recondense above 30 km; unusual sunrises and sunsets.
Colima (México): Lava extrusion ended June 1982 but plume emission continues.
Ol Doinyo Lengai (Tanzania): Tephra emission continues; lava flow.
Langila (New Britain): Explosions build to 6-day strombolian-vulcanian event.
Manam (Bismarck Sea): Rumblings, night glow, increased vapor emissions.
Ruapehu (New Zealand): Possibly pre-eruptive changes continue.
Sakurajima (Japan): Increased explosive activity; rain-caused debris flows.

Long Valley Caldera, California, USA (37.68°N, 118.86°W). As of early March, an average of 10–50 events per day of magnitude ≥1 continued to occur in the southern part of the caldera in the epicentral area of the major January earthquake swarm (see *SEAN Bulletin 7* (12) and *8* (1)). For several months prior to the January swarm the background level of seismicity in the caldera had averaged 8–10 earthquakes of magnitude ≥1 per day. Few larger events were recorded in February, but 5 shocks with magnitudes >3 occurred February 18–19 and a magnitude 4 earthquake was recorded February 24 in the January epicentral region. Heavy snows have severely limited deformation monitoring, but available data suggest that no major changes have occurred since January.

Information Contact: David Hill, Mail Stop 77, U.S. Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025 USA.

Colima Volcano, SW Mexico (19.42°N, 103.72°W). A French team reached the northern rim of the summit cone in early December. Storm damage to trails prevented them from reaching the southern side of the cone, so they were unable to see the southern-flank lava flow produced by the eruption that began in December 1981 (see *SEAN Bulletin 7* (1–3)). Only fumarolic activity was observed in the western part of the crater and on the northern flank. Gas of essentially atmospheric composition was emitted at 500°C from the northeastern part of the cone and from a vent that had recently extruded a lava flow. Rockfalls occurred several times per day from the front of this flow and it may still have been advancing very slowly.

James Luhr and others visited Colima in mid-January and again in early February. The southern flank lava flow appeared to have advanced very little since last observed by Luhr in March 1982. Residents of the area reported that incandescence had ended in June 1982. Plume emission continued in early 1983 at about the same intensity as a year earlier, but there were no episodic increases in intensity of plume emission as there had been in early 1982.

Information Contact: Jean Louis Cheminée, Laboratoire de Géologie, Ecole Normale Supérieure, 46 Rue d'Ulm, 75230 Paris Cedex 05, France; James Luhr, Department of Geology and Geophysics, University of California, Berkeley, CA 94720 USA.

Langila Volcano, New Britain Island, Papua New Guinea (5.53°S, 148.42°E). This report is from P. Lowenstein:

"The increased vulcanian activity of crater 2 in January (see last month's *SEAN Bulletin*) culminated in a rise of the magma column, with an eruptive phase maximum February 11–16. The February 5–11 buildup of the eruption consisted of approximately hour-long periods of loud, rumbling noises, with deep explosion sounds at 5–30 s intervals. Several times per day at irregular intervals individual explosions produced black, ash-laden columns that rose as much as 3–4 km before being dissipated by the northwesterly winds. Night glow, observed February 3, became more intense during this period. Low strombolian fountaining was visible February 3–5 and 9.

"During the 6 days of maximum activity, crater 2 simultaneously displayed continuous strombolian fountaining to 100 m and intermittent powerful vulcanian explosions. Most of the vulcanian explosions were laterally directed, while the continuous moderate vapour emissions and the strombolian fountaining were central and vertical, leading to the conclusion that crater 2 may contain two more or less independent vents.

"Seismic activity consisted of a sub-continuous background of harmonic tremor and strombolian B-type earthquakes. Each individual vulcanian eruption produced large-amplitude, low-period explosion events. The most powerful of these explosions occurred February 12–13 and 15 at the rate of 2–5 per hour.

"Activity diminished rapidly on February 16 and stopped completely on February 17, but harmonic tremor continued. Weak glow was visible on February 19, and vulcanian explosions occurred on February 19 and 23.

"During the eruption, crater 3 (a separate composite cone 300 m west of crater 2) released only weak, white vapours. However, the volume of emission increased to moderate or large during the first 10 days of February, the time of the activity buildup at crater 2."

Information Contact: P. Lowenstein, Senior Government Volcanologist, Rabaul Volcano Observatory, P.O. Box 386, Rabaul, Papua New Guinea.

Meteoritic Events

Meteorite fall: Tennessee, USA, January 28; additional fireball observation.

Fireballs: North Atlantic; Australia (2); Bay of Bengal; Egypt; England; Germany; Italy; Oregon and Washington, USA.

Earthquakes

Date	Time (UT)	Magnitude	Latitude
Feb. 13	0140	6.2 M_s	39.90°N
Feb. 13	0636	5.6 m_b	13.84°N
Feb. 14	0320	6.3 M_s*	54.90°N
Feb. 25	1822	4.8 m_b	42.10°N
Feb. 27	1214	5.8 m_b	35.96°N

Longitude	Depth of Focus	Region
75.10°E	shallow	Southwestern China
144.98°E	169 km	Mariana Islands
159.19°W	shallow	Alaska peninsula
21.51°E	10 km	Yugoslavia
135.85°E	83 km	Japan

*Berkeley measurement 6.5 M_s

Information Contact: National Earthquake Information Service, U.S. Geological Survey, Stop 967, Denver Federal Center, Box 25046, Denver, CO 80225 USA.

EOS

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Cover. The two images form a three-dimensional stereo pair of the lithosphere-asthenosphere boundary for a propagating rift. Viewing this boundary provides insight into the 3-D structure of the rift system. The propagating rift theory offers explanations for a wide range of geological questions, such as the reorientation of oceanic rifts or spreading centers, origin of transform faults; origin of continental rifting, generation of high magnetic anomaly zones, and formation of complex magnetic anomaly patterns in areas such as the Juan de Fuca plate. Additional discussion and a description of how to view the model in 3-D is included in the accompanying article. (Figure courtesy of Phillip D. Milholland and Frederick K. Duennebier.)

Books

Advanced Techniques for Clay Mineral Analysis

Dev. in Sedimentol. 34, J. J. Fripiat (Ed.), Elsevier, New York, vi + 235 pp., 1982, $46.50

Reviewed by Herman E. Roberson

Advanced Techniques for Clay Mineral Analysis is a collection of review articles dealing with nine analytical techniques: thermoanalytical methods, high resolution electron-microscopy studies, neutron scattering techniques, nuclear magnetic resonance, Mossbauer spectroscopy, electron spin resonance, ultraviolet and visible light spectroscopy, far infrared spectroscopy, and electron spectroscopy for chemical analysis (ESCA).

Each chapter includes some discussion of theory as it relates to a particular technique, but the main emphasis according to J. J. Fripiat, the editor, was to be directed toward summarizing recent developments of clay research applications. In fact there is an unevenness in this regard. Some authors (e.g., P. L. Hall on neutron scattering and J. P. Eberhart on high resolution electron-microscopy) have devoted a significant proportion of their articles to theoretical discussion, while other authors (T. J. Pinnavaia on electron spin resonance studies of clay minerals and R. D. Mackenzie on thermoanalytical methods) have no general discussion of theory.

Three areas of study reviewed have been extensively developed by chemists but have only recently received attention from clay researchers: Mossbauer spectroscopy, nuclear magnetic resonance (NMR), and electron spin resonance. Applications of Mossbauer spectroscopy in the study of clays are fairly extensive; as a result the author, B. A. Goodman, makes no attempt to present a comprehensive review. However, these topics which were selected (e.g., identification of oxidation states of iron and identification of iron-containing mineral phases at levels below their limits of detection by other more conventional techniques) will be of interest to many clay researchers. The review of NMR applied to water–clay systems is comprehensive; the clay researcher attempting to get an overview in this research area may want to start here. Electron spin resonance applications which are discussed include studies of the orientation of hydrated metal ions on basal clay surfaces, mobility of interlayer ions, and a number of interlamellar metal complexes.

In his review of high resolution electron-microscopy application, J. P. Eberhart points out that this technique has already been applied with success in the study of several layer silicates (primarily well-crystallized micas). The technique holds promise for the clay mineralogist who is willing to devote himself to gaining a thorough knowledge of the imaging process required for analysis.

ESCA, a relatively new technique, is one that holds great promise for clay research. The technique, because of its high selectivity for the surface of the material being analyzed, has a range of applications that includes adsorption studies as well as studies related to the growth and alteration of clay minerals.

In general the articles are well written and achieve the primary goal: to acquaint the reader with some important analytical techniques which have been recently applied in studies of clay minerals. However, it should be pointed out that excellent review articles on many of the topics covered in this book have been published recently. This, along with the price ($46.50), may curtail sales.

Herman E. Roberson is with the Department of Geological Sciences, State University of New York at Binghamton, Binghamton, New York.

Climatic Geomorphology

J. Büdel (Engl. Transl.), Princeton University Press, Princeton, N.J., xix + 443 pp., 1982, hardbound, $50; cloth, $18.50.

Reviewed by A. T. Grove

Although this book opens with a map of the world showing the continents divided into 10 morphoclimatic regions, this is not simply a text book on geomorphology organized climatically. Rather it is a dissertation which at-

Books *(cont. on p. 124)*

Books (cont. from p. 123)

tempts to provide an explanation for the morphology of the earth. L. C. King had the same ambition, as had W. Penck and, more diffidently, W. M. Davis. One may continue to be impressed by the clarity and visual attractiveness of Davis's exposition, though this satisfied with the integration of its elements; W. Penck's ideas, notably his mechanism for piedmont stairway development, are more difficult to appreciate; King's explanation of upland plains in terms of scarp retreat over immense distances as the result of uplift generated by the disruption of the continents fails to convince most geomorphologists.

A basic problem to be solved is the means by which the land surface is lowered to produce extensive plains developed on solid rock, which may then be dissected, with the preservation of extensive fragments apparently little modified.

The German text from which this book is derived appeared in 1977. Büdel was a pupil of Brückner and Albert Penck. A splendid picture of both of them precedes the contents, one holding an umbrella, the other a hammer, both with pocket watches and seated on a pile of logs. These details are possibly significant in the light of what follows. Of the references, which number over 850, nearly three quarters are in German; 41 are in Büdel himself, the earliest dating from 1933; many are from German university journals with papers by Bremer, Louis, Mensching, and Trodl particularly well represented. H. F. Garner's 'The Origin of Landscapes,' probably the closest approach in English to Büdel's book, is unfortunately attributed first to Caines and then to Gardner.

The gist of Büdel's argument is that landscapes can be explained in terms of the following sequence of events and shifts in climatic zonation.

(1) In Tertiary times, seasonally wet warm climates extended from the equator to the poles and etchplains were created worldwide by the mechanism of double planation. This is assumed to result from the fact that chemical weathering at the base of the weathered layer is more intense than anywhere else in the world because the soil fauna and flora supply large quantities of carbonic acid, and the water is renewed every rainy season. Along joint planes decomposition takes place particularly deeply giving great thicknesses of grus with core stones. Rock masses protruding above the soil are regarded as exempt from such weathering and between these shield inselbergs. 'Surface wash in the shifting network of tiny rainy season rivulets and wash channels' is regarded as 'the decisive process causing planation' (p. 146).

(2) By the Late Pliocene, climatic zones were becoming differentiated with the development of polar icecaps, and etchplain development was increasingly confined to middle and low latitudes. 'The main areas of today's rivers became fixed at medium elevations in Central Europe' (p. 259), and high valley systems formed in the Alps give the trough shoulders of glaciated valleys. Pediment formation began as essentially a rimming process mainly confined to deserts with cold winters and the production of abrasive frost debris.

(3) The Pleistocene is viewed as involving in its last quarter a fourfold expansion and retreat of icecaps. Tundra processes in middle latitudes resulted in the rapid incision of box valleys 100 to 300 m deep, largely because of the disruptive effects of 'ice rinds' ground ice immediately below the active layer, which 'promotes both vertical and lateral erosion and is the driving force causing the periglacial frost debris zone to be morphodynamically the zone of excessive valley-cutting' (p. 105). At the same time, inselbergs were removed by frost action. In warm deserts, soil sheets were replaced by rubble sheets, and basal surfaces of etchplains were extensively revealed by stripping away of the weathered layer, especially along lines corresponding with the direction of the trade winds.

(4) The Holocene period has been so short that only a few percent of the relief can be ascribed to it. This is particularly the case in the middle latitudes, best known to most geomorphologists, where processes are peculiarly weak except where they have been artificially accelerated by deforestation.

This scheme is exemplified by various regional examples taken mainly from southern Germany and southeast Europe.

Büdel's exposition can be criticized on various grounds. Too often he asserts without presenting evidence. More support is needed, for instance, for the claim on p. 124 that the intense chemical weathering taking place in the peritropical zone 'exceeds all chemical weathering found in any other climate' first really 'self evident, therefore, that these driers' of the peritropical zone 'must vary enormous amounts of dissolved matter, for it is the tropics above all that many rocks are particularly susceptible to solution' (p. 129). Throughout, there is too little attempt to provide chronological control through the use of existing isotopic dates of intrusive and extrusive rocks. Nevertheless one can welcome the forthright emphasis on the reliance of present-day forms on processes no longer operating on them and the acute comments based on field observation. I particularly appreciated a section on the Inntal of Olympia (pp. 338–340).

Perhaps this volume, by reintroducing British and American geomorphologists to a tradition they abandoned a generation ago, will lead some of them to attempt a reassessment of the morphology of the earth. While it could well be comparable to that of Büdel, such a reassessment should take fuller account of the advances made over the last two decades in knowledge of plate tectonics, the Cenozoic climatic record, and geomorphic processes, and it should not neglect the enhanced opportunities remote sensing has given us of the form of the surface and what lies beneath it.

A. T. Grove is the director of the African Studies Centre, University of Cambridge, Cambridge, United Kingdom

Classified

RATES PER LINE

Positions Wanted: first insertion $1.75, additional insertions $1.50.

Positions Available, Services, Supplies, Courses, and Announcements: first insertion $3.50, additional insertions $2.75.

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There are no discounts or commissions on classified ads. Any type style that is not publisher's choice is charged at general advertising rates. Eos is published weekly on Tuesday. Ads must be received in writing on Monday of the week prior to publication.

Replies to ads with box numbers should be addressed to Box ___, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

For further information, call toll-free 800-424-2488 or, in the Washington, D.C., area, 462-6903.

POSITIONS AVAILABLE

Postdoctoral Position in Physical Oceanography. A postdoctoral appointment in physical oceanography will be available beginning September, 1983 in the College of Marine Studies, University of Delaware, Newark, Delaware. The initial appointment will be for one year with probable extension for a second year. The salary will be $20,000–$24,000 per year, depending on experience. Funds for the position will be available largely from a grant by NSF for conduct and analysis of a field observational study of the shelfbreak front in the Middle Atlantic Bight.

The person obtaining the appointment would be responsible for a portion of the planning and execution of the field study, much of the subsequent data analysis and interpretation, and teaching of one graduate level course in physical oceanography each year. The successful applicant must have received the Ph.D. in physical oceanography or a closely related field by the starting date of his appointment. Preference will be given to applicants with direct experience in field observations.

To apply send a complete resume and the names of three references to Professor R. W. Garvine, College of Marine Studies, University of Delaware, Newark, DE 19711. (Telephone: (302) 738-2169).

The University of Delaware is an equal opportunity/affirmative action employer.

Postdoctoral Research Associate in Geophysical Fluid Dynamics/University of Southern California. Applications are invited for a research appointment in Geophysical Fluid Dynamics. The successful applicant would be expected to spend the majority of his time working on laboratory models of coastal upwelling. Appointment can begin immediately. Applicants should possess a recent Ph.D. degree in a relevant area of engineering, oceanography or physics. A complete resume and at least three letters of recommendation should be sent to Prof. T. Maxworthy, OHE 430, Department of Mechanical Engineering, University of Southern California, Los Angeles, CA 90089–1453.

EOE/M/F/H

Assistant Professor/University of Alberta. The Department of Physics at the University of Alberta invites applications for a tenure track position at the level of an Assistant Professor in Physics in any of the following areas:

1. Astrophysics and Astronomy;
2. Geophysics (Electromagnetic methods);
3. Theoretical Physics (Medium Energy, Particle Physics, Relativity and Cosmology).

The 1982/83 salary range for an Assistant Professor is $27,720–$39,820 per annum.

Applications will be received until May 1, 1983, and the expected appointment date is July 1, 1983.

The Department of Physics offers both undergraduate and graduate degrees in Physics and Geophysics. The Department currently consists of 47 Faculty Members, 36 Research Associates and Post-Doctoral Fellows and 80 Graduate Students.

Candidates interested in applying should submit a curriculum vitae plus the names of three (3) referees to:

Dr. A. N. Kamal
Chairman
Department of Physics
University of Alberta
Edmonton, Alberta, Canada
T6G 2J1

The University of Alberta is an equal opportunity employer but, in accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

President/University Corporation for Atmospheric Research (UCAR), Boulder, Colorado. The Search Committee of the UCAR Board of Trustees invites nominations and applications for the President and Chief Executive Officer of UCAR. The Board of Trustees expects to fill the position promptly and seeks to have the individual in office on July 1 or as soon after 1 July 1983 as possible.

UCAR is a private, nonprofit consortium of 48 U.S. and two Canadian institutions with doctoral programs in the atmospheric sciences and related fields. UCAR's major activities consist of overseeing the programs of the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, and the National Scientific Balloon Facility (NSBF) in Palestine, Texas, and managing their operations; the planning and conduct of special, cooperative atmospheric research in the national interest; and fostering atmospheric research in the national interest.

To be considered for the UCAR presidency, a person should have demonstrated imaginative scientific and management leadership ability of high quality and specific knowledge of the atmospheric and related sciences. A complete description of the duties and responsibilities of the President and qualifications for the candidates may be obtained by writing to Dr. Donahue (address below). Applications and nominations, which should be postmarked no later than 8 May 1983, should be addressed to:

Dr. Thomas M. Donahue
Chairman, Search Committee
UCAR
P.O. Box 3000
Boulder, Colorado 80307

UCAR is an equal opportunity, affirmative action employer.

Faculty Positions/The University of Iowa. The Department of Physics and Astronomy anticipates one or two openings for tenure-track assistant professors or visiting professors of any rank in August 1983. Preference will be given to experimentalists in any area for the tenure-track position. Current research interests include astronomy, atomic, condensed matter, elementary particle, laser, nuclear, plasma, and space physics. The positions involve undergraduate and graduate teaching, guidance of research students, and personal research. Interested persons should send a résumé and a statement of research interests, and have three letters of recommendation sent to *Search Committee, Department of Physics and Astronomy, The University of Iowa, Iowa City, IA 52242.*

The University of Iowa is an equal opportunity/affirmative action employer.

Chairman—Department of Geological Sciences, Wright State University. The Department of Geological Sciences, invites applications for the position of chairman, to be appointed September 1983. We seek a dynamic individual with administrative talent and an appreciation for research and practice-related educational activities. Rank is at the full professor level and no restrictions have been placed on areas of specialization. The department is active with 12 faculty and an emphasis on professional practice, yet maintaining a firm commitment to basic research.

Send a letter of application, curriculum vitae and names of three references to:

Chairman, Search Committee
Department of Geological Sciences
Wright State University
Dayton, OH 45435.

Wright State University is an affirmative action/equal opportunity employer. Closing date for the position is October 31, 1983.

Sedimentary Geology/University of Pittsburgh. The Department of Geology and Planetary Science invites applications for a tenure-stream faculty position in sedimentary geology at the assistant professor level, which is expected to be open beginning September 1983. We seek candidates with expertise in one or more of the following fields: sedimentary petrology, sedimentation, stratigraphy, sedimentary geochemistry, and economic geology of non-metallic deposits. The position involves development of a vigorous research program, supervision of graduate student research, and teaching of undergraduate and graduate courses.

Applicants should submit a letter of application, a statement of research interests, transcripts, vita, and arrange to have three letters of recommendation sent to:

Dr. E. G. Lidiak, Chairman, Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA 15260

An Equal Opportunity Employer

Postdoctoral Position in Solar-Terrestrial Physics. The Center for Atmospheric and Space Sciences of Utah State University has a postdoctoral position in solar-terrestrial physics. The position is for one year but has renewable opportunities. The recipient is expected to develop theoretical models to describe the large-scale flow of plasma in the terrestrial ionosphere and magnetosphere and to study the stability of the flows. Candidates should have a Ph.D. and a background in space physics and/or plasma physics. Send letter of application, resume, and the names and addresses of two references to April 30 to Professor R. W. Schunk, Center for Atmospheric and Space Sciences, Utah State University, Logan, Utah 84322 (801-750-2974).

Utah State University is an affirmative action/equal opportunity employer.

DEAN OF GEOSCIENCES TEXAS A&M UNIVERSITY

Texas A&M University invites applications and nominations for the position of Dean of Geosciences.

QUALIFICATIONS: Dean of the College of Geosciences should have national or international reputation for excellence in teaching, research, and/or administration in at least one of the fields of geoscience represented at Texas A&M University. (Geography, Geology, Geophysics, Meteorology, and Oceanography).

Evidence of such competence should be demonstrated by the individual's history relative to publications, honors, professional associations, participation in national councils, and advisory panels and in positions and appointments. This history should include evidence of appreciation and understanding of management problems on all levels, demonstrated ability to make decisions, to administer programs, delegate authority and establish policy with sensitivity, diplomacy, fairness, firmness and dispatch.

Of much importance for the College of Geosciences at Texas A&M University is the Dean's ability to establish favorable rapport with industry and government, particularly with reference to sources of research funding. The Dean should be characterized by his/her ability to communicate effectively. The Dean must be endowed with sufficient desire and vision to lead the College to a high position of national prominence.

TEXAS A&M UNIVERSITY: Texas A&M University is a rapidly-growing four-year, state-supported, university with enrollment exceeding 35,000 students. The university is located in College Station, TX approximately 90 miles from Houston, TX. The twin cities of Bryan and College Station have a combined population exceeding 100,000 people.

CONDITIONS OF EMPLOYMENT: This is a 12-month position available on or before September 1, 1983. Salary is competitive and negotiable.

APPLICATION PROCEDURE: The application should have at least three references who are familiar with the applicant's or nominee's background in higher education administration.

The deadline for application is April 15, 1983. Send letters of application and nomination to:

Dr. Charles E. McCandless
Associate Vice President for Academic Affairs and Chairman, Search Committee
Texas A&M University
College Station, TX 77843.

Texas A&M is an equal opportunity employer.

UNIVERSITY OF CAPE TOWN
Chair in Analytical Science

Applications are invited for appointment to the above post with effect from 1 February 1984.

The University wishes to appoint a scientist with an established research record to take responsibility for the further development of research and teaching in this recently created department. Candidates currently occupying either academic or non-academic positions should have a wide knowledge of modern instrumental analysis and this requirement will be of prime importance in making the selection for the post.

Appointment, depending on qualifications and experience, will be made in the salary range R23 109 to R30 255 per annum, to which is added an annual service bonus of nearly one month's salary.

Applicants should submit a full resumé and the names and addresses of three referees whom the University may approach.

Further information should be obtained from the Registrar (Attention: Appointments Office), University of Cape Town, Private Bag, Rondebosch, 7700, South Africa, by whom applications (quoting ref. no. SM/332) must be received not later than 24 June 1983.

UCT is an equal opportunity employer.

Faculty Position/Physical Oceanography, University of Maryland Center for Environmental and Estuarine Studies (UMCEES). The Horn Point Environmental Laboratories of UMCEES invite applications for a tenure-track (rank open) position for a physical oceanographer. The physical oceanographic program is young and developing, so that candidates with a wide range of research interests will be considered. Opportunities exist for oceanographers with experimental, theoretical, or numerical modeling skills. In addition, the strong chemical and biological programs provide opportunities for interdisciplinary research. Although some preference will be given to applicants with interests in continental shelf and estuarine circulation processes, the primary criterion for selection of the successful candidate is the ability to develop a strong research program. The closing date for applications is May 16, 1983. Applications and a list of references should be sent to:

Dr. William C. Boicourt
Chairman, Search Committee
University of Maryland
Center for Environmental and
Estuarine Studies
Horn Point Environmental Laboratories
P. O. Box 775
Cambridge, Maryland 21613.

The University of Maryland is an Affirmative Action/Equal Opportunity Employer.

Hydrogeologist. Applications are invited for a hydrogeologist—engineering geologist position starting in January 1984. Rank and salary are dependent on qualifications and experience. Ph.D. degree and registration as a professional engineer desirable.

Responsibilities will include undergraduate and graduate teaching and graduate research in hydrogeology and engineering geology. Applicants should have experience in field groundwater investigations of regional site specific nature/groundwater resource analyses/waste disposal/groundwater contamination studies. Experience in applying remote sensing to hydrogeology and engineering studies would be helpful.

Send resume and names of three references to J. J. Finney, Head, Geology Department; Colorado School of Mines, Golden, Colorado 80401. Applications will be accepted until September 15, 1983. The Colorado School of Mines is an affirmative action/equal opportunity employer.

UNIVERSITY OF CAPE TOWN
Research Officer: Economic Geology

Applications are invited for the above vacant post in the Department of Geology. The initial appointment will be for a three-year period.

The successful applicant will conduct research primarily in the field of Economic Geology and will also do some teaching within the Department. He or she will work closely with Professor L Minter in establishing a research programme in Economic Geology at the University of Cape Town.

Applicants should have a Ph D degree or equivalent research experience. Appointment will be made according to qualifications and experience in the salary range R12 657 to R22 173 per annum. Staff benefits include an annual bonus of nearly one month's salary, pension, medical aid and a housing subsidy subject to State regulations.

Applicants should submit a curriculum vitae stating research interests, age, present salary, experience and qualifications, the date duty could be assumed and the names of three referees.

Further information is obtainable from Professor A M Reid, Department of Geology, University of Cape Town, Private Bag, Rondebosch, 7700, South Africa, by whom applications should be received by 31 May 1983.

The University's policy is not to discriminate on the grounds of sex race or religion.

Geochemist. A career position is available in the Earth Sciences Department at Lawrence Livermore National Laboratory, Livermore, California, for a Geochemist, or a person with related training or experience, to provide geochemical modeling support to the evaluation of repository sites for the disposal of nuclear waste.

The work involves developing and extending existing geochemical computer codes, updating thermodynamic data bases and experimental work in support of and to validate the geochemical models. Requires knowledge of FORTRAN, an advanced degree or equivalent in Geochemistry, Physical Chemistry or Inorganic Chemistry, and experience in developing and using computer codes to solve geochemical problems.

Send detailed resume with full employment history and objectives to Art Wong, Professional Employment Division, LAWRENCE LIVERMORE NATIONAL LABORATORY, P. O. Box 5510, KES-033, Livermore, CA 94550. U.S. citizenship is required.

An equal opportunity employer M/F/H/V.

Mineralogy and Petroleum Geology/Eastern Washington University. The Department of Geology is seeking applicants for a faculty position in mineralogy and one in petroleum geology. Doctoral degree required. Mineralogist to teach mineralogy and x-ray diffraction/fluorescence. Petroleum geologist with industrial experience to teach petroleum geology and some area of soft rock geology. Both positions require teaching undergraduate/graduate courses in area of specialization plus introductory geology. Development of strong research program expected. Positions start September 1, 1983. Evaluation of applications begins April 30, 1983. Send letter of application, vita, and 4 letters of recommendation to Dr. Eugene Kiver, Search Committee, Department of Geology, Eastern Washington University, Cheney, Washington 99004.

AA/EOE.

Research Position/Space Physics. The Space Physics and Astronomy Department at Rice University seeks applicants for one or more full-time research positions within the department. Successful applicant(s) will play key role(s) in the development of theoretical three-dimensional models of the Earth's electromagnetic field. Applicants should have knowledge of, and interest in, at least one of the following areas: solar-wind magnetosphere interactions, magnetosphere-ionosphere coupling, ionosphere-atmosphere coupling, atmospheric electricity. Experience and/or interest in numerical modeling is an important consideration.

Title and salary level commensurate with experience, ranging from one-year Research Associateship (renewable in subsequent years depending on performance) to open-ended Research Scientist appointment in the Center for Space Physics. Please send resume and names of three professional references to T. W. Hill or R. A. Wolf, Space Physics and Astronomy Department, Rice University, Houston, TX 77251.

The University is an equal opportunity/affirmative action employer.

Staff Scientists/Systems Analysts. Research and Data Systems, Inc. has openings available for Staff Scientists, Systems Analysts and Programmer/Analysts to work in areas involved in the processing and application of data from satellite based remote sensing systems. Particular needs involve the analysis and processing of Earth Radiation Budget, Microwave, AVHRR and LANDSAT data. Needs also exist in the areas of interactive image graphics, software engineering, realtime processing and satellite data communications. Successful candidates will have an advanced degree in meteorology, physics, engineering, mathematics, or computer science. Hardware background should include IBM, DEC, CYBER or HP-1000 equipment. Send resume in confidence to:

Research and Data Systems, Inc.
10300 Greenbelt Road, Suite 206
Lanham, Maryland 20706
Telephone: (301) 390-6100.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

May 9–13, 1983, "Planning, Design, and Operation of Real-Time Data Monitoring Systems and Applications." $750.00. Topics include remote-site sensors and telemetry equipment, communications systems options (satellite, radio line-of-sight, telephone, etc.), data collection platforms, computer systems software, data base design and management, applications that include flood control, irrigation, hydropower production, hydrological and meteorological data collection, water quality, air pollution, acid rain, groundwater levels and quality, etc., economics of real-time data collection, use of radar information, current status of hardware, computer graphics and computer imagery for remote sensing. For additional information, contact Dr. Raid S. McQuivey, Sutron Corporation, 11150 Main Street, Fairfax, Virginia (703) 591-8010.

Engineering Analysis of Fluvial Systems

August 1-4, 1983
Copper Mountain Resort, Colorado

State-of-the-art design techniques oriented to solving practical engineering problems associated with watersheds and rivers are presented in this four day short course. The course is designed to enhance the participants' insight into physical processes and the associated mathematical modeling techniques. Design applications are illustrated with numerous case studies. The recently published hardbound text *Engineering Analysis of Fluvial Systems* will be provided to each participant.

Lecturers: D.B. Simons, R.M. Li, and P.F. Lagasse

Registration fee: $450 U.S. Dollars

Contact: Dr. Peter F. Lagasse
Simons, Li & Associates, Inc.
P.O. Box 1816
Fort Collins, CO 80522
(303) 223-4100

STUDENT OPPORTUNITIES

IBM Environmental Engineering Graduate Fellowship. Colorado State University invites applications from students interested in a Ph.D. engineering program with specialties in water quality hydrology and water quality monitoring. The fellowship provides a $1,000/month stipend, all tuition and fees, books, research expenditures and travel funds. For further information or application, please write.

Dr. Robert C. Ward
Department of Agricultural and
Chemical Engineering
Colorado State University
Fort Collins, CO 80523

Colorado State University is an equal opportunity employer.

RESEARCH POSITION IN GEODYNAMICS-ASTROMETRY

At the Lunar Satellite Ranging Facility
Haleakala Observatory, Maui, Hawaii

The University of Hawaii's Institute for Astronomy has an immediate opening for a Researcher.

The selected applicant will work closely with the Observatory Project Manager to ensure an effective program of ranging on artificial satellites and the moon; will also conduct a research program in an area of interest to the facility; and will be a resident on the island of Maui. Minimum Qualifications: Ph.D. in Geosciences, Astronomy, or Physics and a proven record as a researcher as demonstrated by a list of publications and recommendations of peers.

The position is full-time, federally funded, subject to annual contract renewal, and continuation dependent upon availability of funds. Salary will be commensurate with qualifications and experience.

Interested individuals should send a bio-bibliographical summary together with the names of two or three people who have knowledge of the applicant's professional abilities to: **Ms. Carol Yoshida, Personnel Officer, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, Hawaii 96822.** Further details can be obtained from Dr. John T. Jefferies, Director at (808) 948-8566. Applications should be postmarked no later than April 29, 1983.

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AGU

Membership Applications Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation; the letter A denotes the Atmospheric Sciences section, which was formerly the Meteorology section.

Regular Member

David R. Bazard (GP), Stephen Blake (V), Soman Chacko (S), Don W. Chorley (H), Edward Cranswick (S), David A. Dinter (T), Roger R. Eaton (H), Fred G. Everdale (O), Ingrid P. Fotino (O), Christopher Fox (T), Robert H. Gilkeson (H), Douglas D. Given (S), Arthur Goldstein (T), Edward J. Green (O), Margaret Hellweg (S), Alexander D. Jack (S), Cathy J. Janik (V), Douglas W. Johnson (A), Jacob Kushnit (O).

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A certificate of appreciation from the president will be given for contributions totaling $500 for the 5 years (1981–1985).

Contributors of $1000 or more will be individually recognized in a permanent display at the headquarters of the Union.

The June Bacon-Bercey Scholarship in Atmospheric Sciences for Women 1983–1984

Expressly for women intending to make a career in the atmospheric sciences. This monetary assistance, provided through a gift from June Bacon-Bercey, a noted meteorologist, will be given to a woman who shows academic achievement and promise. To qualify, candidates must be one of the following:

- a first-year graduate student in an advanced degree program in atmospheric sciences;
- an undergraduate in a bachelor's degree program in atmospheric sciences who has been accepted for graduate study;
- a student at a 2-year institution offering at least six semester hours of atmospheric sciences, who has been accepted for a bachelor's degree program, and who has completed all of the courses in atmospheric science offered at the 2-year institution.

Awardee selection will be made by the AGU Subcommittee on Women in Geophysics in consultation with the AGU Atmospheric Sciences Section.

For application forms contact:
American Geophysical Union
Member Programs Division
2000 Florida Avenue, N.W.
Washington, D.C. 20009

462-6903
800-424-2488 outside the Washington, D.C. area

Application Deadline
May 1, 1983

Meetings

Announcements

Call for Papers: Chapman Conference on Magnetic Reconnection

A Chapman Conference on 'Magnetic Reconnection' will be held at the Los Alamos National Laboratory, Los Alamos, New Mexico, October 3–7, 1983. Since its conception over three decades ago as a possible solar flare mechanism, magnetic reconnection has become a matter of substantial interest and probable importance not only for flares but also for other domains of plasma physics, including planetary and stellar magnetospheres and laboratory fusion research. The main emphasis of this meeting will be on magnetic reconnection in the earth's magnetosphere, but the perceived role of reconnection in other cosmic objects and in laboratory plasmas will also be treated to provide a full picture of the present understanding of this process.

Specific areas of discussion will include the following topics: theories of reconnection and its anticipated signatures, reconnection at the earth's magnetopause, reconnection in the earth's magnetotail, reconnection in astronomical objects, reconnection in laboratory plasmas, computer modeling of reconnection, and directions for future research.

The 4½-day conference will include morning sessions plus a mix of afternoon and evening sessions that will leave sufficient time for discussion. Poster papers will be encouraged and will be previewed and displayed so as to optimize their communication to Conference participants. Arrangements will be made to provide to attendees during the meeting a volume of extended summaries of the papers and to publish conference papers in book form afterward.

All who are interested in attending and in receiving later information circulars should write to Magnetic Reconnection Meeting, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009 (telephone, toll free: 800-424-2488 or, in the D.C. area, 462-6903).

To submit an abstract, follow the abstract format published in *Eos*, November 30, 1982, and January 18, 1983. There will be no abstract charge. All abstracts should be sent to Magnetic Reconnection Meeting, AGU, at the address in the previous paragraph.

ABSTRACTS DEADLINE JULY 1, 1983

Program Committee: E. W. Hones, Jr., Los Alamos National Laboratory; V. M. Vasyliunas, Max-Planck-Institute for Aeronomy, Katlenburg-Lindau, FRG; F. Coroniti, Department of Physics, UCLA; D. N. Baker, Los Alamos National Laboratory; D. H. Fairfield, NASA Goddard Space Flight Center; A. Nishida, Institute of Space and Astronautical Science, Tokyo; J. Brackbill, Los Alamos National Laboratory; C. T. Russell, Institute of Geophysics and Planetary Physics, UCLA; B. U. Ö. Sonnerup, Radiophysics Laboratory, Dartmouth College.

Student Travel: Limited funding is available to support student travel expenses to the conference. To apply, write to AGU giving your educational background, your reasons for wanting to attend the conference, and your research interests. The awardees will be selected by AGU in conjunction with the program committee. Deadline for travel applications is July 1, 1983.

Hydrology Days Update

The AGU Front Range Branch Hydrology Days symposium will be held at the Colorado State University in Fort Collins, April 19–21.

The 28 papers to be presented will cover such topics as flow resistance of boulder-bed streams; snowmelt runoff simulation using the Martinec-Rango model; long-term models of phosphorous in completely mixed lakes; multilayered aquifer modeling; the rainfall-runoff process from a geomorphic-hydraulic perspective; infiltration, soil moisture redistribution, soil evaporation, and aquifer recharge in the HEC 1 (Hydrological Engineering Center) model; approaches for estimating regional snowpack equivalent; and variability of bed material transport and channel hydraulics with high washload concentrations.

The AGU Front Range Branch Hydrology Days (*Eos*, November 2, 1982, p. 838, and July 27, 1982, p. 589) is dedicated to Robert E. Glover in recognition of his contributions to hydrology. Glover, on the faculty of Colorado State University from 1956 to 1983, is currently a faculty affiliate.

For more information, a complete program, and registration materials, contact H. J. Morel-Seytoux, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523 (telephone: 303-491-5448).

Geophysical Year

New Listings

The complete Geophysical Year last appeared in the December 21, 1982, *Eos*.

A boldface meeting title indicates sponsorship or cosponsorship by AGU.

August 29–September 8, 1983 4th International Symposium on Water–Rock Interaction, MISASA, Japan. (Professor H. Sakai, Secretary-General, WRI-4, Institute for Thermal Spring Research, Okayama University, MISASA, Tottori-Ken 682–02, Japan.)

September 30–October 1, 1983 Pacific Northwest Regional Meeting, Bellingham, Wash. (Myrl E. Beck, Jr., PNAGU, Department of Geology, Western Washington State College, Bellingham, WA 98225.)

GAP

Separates

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Aeronomy

0410 Absorption and Scattering of Radiation
OZONE DENSITIES IN THE LOWER MESOSPHERE MEASURED BY A LIMB SCANNING ULTRAVIOLET SPECTROMETER
G.W. Sasch (Laboratory for Atmospheric and Space Physics and Department of Astro-Geophysics, University of Colorado, Boulder, CO 80309), G.H. Mount, C.A. Barth, ...

[illegible]

Electromagnetics

[illegible]

Geochemistry

1410 Chemistry of the Atmosphere
KINETICS AND MECHANISM OF THE OXIDATION OF S(IV) BY OZONE IN AQUEOUS SOLUTION WITH PARTICULAR REFERENCE TO SO_2 CONVERSION IN NONURBAN TROPOSPHERIC CLOUDS
H. G. Maahs ...

[illegible]

Hydrology

[illegible]

Oceanography

[illegible]

Particles and Fields—Interplanetary Space

[illegible]

Particles and Fields—Ionosphere

[illegible]

Particles and Fields—Magnetosphere

[illegible]

... region $\xi \lesssim 15\ R_e$ upstream of the Earth's bow shock (measured along the interplanetary magnetic field) which dominates ion propagation, influences the global distribution of fluxes in the foreshock, and may play a role in acceleration of the ions. When IMP-8 is beyond $\xi \sim 11\ R_e$, the propagation appears to be essentially scatter-free between IMP-8 and ISEE-1; this is deduced from the absence of earthward fluxes at IMP-8 as well as the tendency for the spin-averaged fluxes to be comparable at the two spacecraft.
J. Geophys. Res., Blue, Paper 1A0198

Physical Properties of Rocks

0110 Elasticity, Fracture and Flow.
BOREHOLE FRACTURE PARAMETERS FROM THE INTERPRETATION OF WELL TIDES.
Don B. Bower (Department of Energy, Mines and Resources, Earth Physics Branch, Gravity, Geothermics and Geodynamics Division, 1 Observatory Crescent, Ottawa, Ontario, Canada. K1A 0Y3)

This paper presents a theory to account for the main features of the tidal response of an isolated plane fracture as revealed by the water level in an intersecting open borehole. According to the theory, the diurnal and semidiurnal tidal constituents (both amplitude and phase) of water level variations depend on the fracture aperture, the orientation (dip and strike) and the radial extent of the fracture, and the compressibility of the aquifer. The theory is applied to water level observations made in six open boreholes located in crystalline rock at a test site at the Chalk River Nuclear Laboratories, Atomic Energy of Canada Limited in Chalk River, Ontario, Canada. The boreholes were uncased and intersected many open fractures so that a definitive test of the theory could not be made. However, in four cases a fracture model could be found which fitted the observations within the experimental error.
J. Geophys. Res., Red, Paper 3B0429

0110 Elasticity, Fracture and Flow
STRESS CORROSION AND CRACK PROPAGATION IN SIOUX QUARTZITE
Lindaree Peck (Department of Geology and Geophysics, Yale University, New Haven, Connecticut, 06511)

Water-induced changes in the amount of specific energy (energy per unit area) consumed during crack extension in Sioux quartzite were determined using the analysis of linear elastic fracture mechanics. Wedge-loaded double cantilever beam test specimens were cracked in air, water, and aqueous solutions of NaOH, HCl, NaCl and methanol at crack velocities of 4.1×10^{-4} to 4.2 mm/s and temperatures of 17–60°C. Scanning electron microscopy and the determination of enhanced permeability were used to detect fracture-induced microcracks.

The fracture energy of Sioux quartzite in water is 15% lower than that of quartzite cracked in air (ambient humidity). The dependence of the fracture energy on crack velocity (time) and on the concentration of water in the test environment is characteristic of the occurrence of stress corrosion as a mechanism of enhanced crack growth in the presence of water. Increased crack velocity in quartzite cracked in hot water is evidence of thermally enhanced water-weakening, but the fracture energy of quartzite cracked in hot air or hot water (40–60°) is 12–15% higher than room temperature values. The increase in fracture energy upon heating the quartzite is attributed to changes (reduction in residual stress, existence of thermal stresses) in the net stress field responsible for microcracking and crack propagation in the quartzite. [Stress corrosion, crack propagation].
J. Geophys. Res., Red, Paper 3B0412

[illegible]

Planetology

[illegible]

... the colder, subsurface permafrost (at ~ 3 cm depth) and yield pressures of ~ 10^{-12} bar. The subsurface cold trapping model explains many but not all observations relevant to Io's atmosphere. The new basal pressure model and the earlier surface frost equilibrium model, when taken together, provide, respectively, lower and upper limits on the basal SO_2 pressure of Io's atmosphere. (Io atmosphere, Io surface, sulfur-dioxide, regolith, coldtrapping).
J. Geophys. Res., Blue, Paper 3A0101

Seismology

0040 Phenomena (Earthquake prediction)
RADON AND TILT ANOMALIES DETECTED BEFORE THE IRPINIA (SOUTH ITALY) EARTHQUAKE OF NOVEMBER 23, 1980 AT GREAT DISTANCES FROM THE EPICENTER.
L. Allegri, F. Bella, G. Della Monica, A. Ermini, S. Improta, V. Sgrigna and P.F. Biagi (Istituto di Fisica, Universita' di Roma, P.le A. Moro 2, 00185 Roma, Italy)

A strong earthquake (M=6.5) occurred on November 23, 1980 in South Italy (Irpinia region) at hypocentral depth ranging between 10 Km and 18 Km. Anomalous variations in groundwater radon content, 21% and 170% compared with the background level, were detected at Rome and Rieti sites before the earthquake. A tilt anomaly, 10 rad in amplitude, was observed at L'Aquila site. All the stations were located at distances of about 250 Km from the epicenter. The anomalous duration, for both the examined parameters, lasted five-six months. We suggest to interpret such anomalies as precursors of the Irpinia earthquake. (Radon, tilt, earthquake prediction).
Geophys. Res. Lett., Paper 3L0107

6950 Seismic sources (mechanisms, magnitude, frequency spectrum, space, and time distribution)
BREAKING OF A SINGLE ASPERITY: RUPTURE PROCESS AND SEISMIC RADIATION
S. Das (Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964) and B. V. Kostrov

The problem of spontaneous shear rupture of a single circular asperity on an infinite fault plane is studied. Initially, the fault plane is broken everywhere except at a circular asperity. An applied displacement at infinity results in a stress concentration along the bounding edge of the asperity. The frictional stress on the broken part of the fault plane is taken to be a constant. Once a point on the asperity breaks, the stress there drops to the same value as on the 'main' fault surface. The rupture is started by raising the shear stress at a point on the asperity edge and is then allowed to propagate spontaneously using a critical stress level fracture criterion. The rupture process is calculated numerically. It is found that for asperities of constant strength, the rupture first propagates around the edge of the asperity and then inward, a phenomenon best described by the well-known term of classic military maneuver - 'the double encircling pincer movement'. In the appendix, the expressions for the far-field seismic radiation due to the rupture of such an asperity are derived. It is shown that the n-th cartesian component of the far-field displacement at (x,t) for P, SV and SH waves, using the notation of Aki and Richards [1980], is given by

$$u_n(\mathbf{x},t) = \frac{D_{ni}}{4\pi\rho c^3 R} \iint_{S_0} \dot{\tau}_{zi}\left(\xi, t - \frac{R - \hat{\xi}\cdot\gamma}{c}\right) dS(\xi)$$

Thus, the far-field pulses can be directly found from the stress-drops on the fault-plane. This formula is also true for 'crack' or 'dislocation' problems. The directivity function D_{ni} for displacement for the asperity problem is found to be that for the double couple, modified by some factor. In particular, the fault plane is a nodal plane for SV waves. (Circular asperity, rupture, seismic radiation).
J. Geophys. Res., Red, Paper 3B0269

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